

WHAT IS CLAIMED IS:

1. A method for manufacturing a semiconductor device, comprising the steps of:

forming a laminate comprising a lower first conductive layer and an upper second conductive layer over a semiconductor layer with a gate insulating film interposed therebetween;

forming a mask pattern over the laminate;

using a condition that has a fast etching rate of the mask pattern and etching the second conductive layer and the first conductive layer to form a tapered first conductive layer pattern;

selectively etching the second conductive layer in the first conductive layer pattern in accordance with the mask pattern left over the first conductive layer pattern to form a second conductive layer pattern; and

forming a lightly doped drain region in a region of the semiconductor film overlapping with the first conductive layer in the second conductive layer pattern with the second conductive layer in the second conductive layer pattern as a mask for shielding ions accelerated by an electric field.

[Name of Document]—Abstract

[Abstract]

[Object] 2. The method according to claim 1, wherein the first conductive layer is tantalum nitride, and the second conductive layer is titanium or one of an alloy and a compound including titanium as its main component.

3. The method according to claim 1, wherein the second conductive layer and the first conductive layer are etched while recessing the mask pattern over the laminate with the use of plasma to which sulfur hexafluoride is added to form the tapered first conductive layer pattern.

4. A method for manufacturing a semiconductor device, comprising the steps of:

laminating a first conductive layer, a second conductive layer, and a third conductive layer sequentially over a semiconductor layer with a gate insulating film interposed therebetween to form a laminate;

forming a mask pattern over the laminate;

using a condition that has a fast etching rate of the mask pattern and etching the third conductive layer, the second conductive layer, and the first conductive layer to form a tapered first conductive layer pattern;

selectively etching the third conductive layer and the second conductive layer in the first conductive layer pattern in accordance with the mask pattern left over the first conductive layer pattern to form a second conductive layer pattern; and

forming a lightly doped drain region in a region of the semiconductor film overlapping with the first conductive layer in the second conductive layer pattern with the third conductive layer and the second conductive layer in the second conductive layer pattern as a mask for shielding ions accelerated by an electric field.

5. The method according to claim 4, wherein the first conductive layer is

tantalum nitride, the second conductive layer is titanium or one of an alloy and a compound including titanium as its main component, and the third conductive layer is titanium nitride.

5       6. The method according to claim 4, wherein the first to third conductive layers are etched while recessing the mask pattern over the laminate with the use of plasma to which sulfur hexafluoride is added to form the tapered first conductive layer pattern.

10       7. A method for manufacturing a semiconductor device, comprising the steps of:

forming a laminate comprising a lower first conductive layer and an upper second conductive layer over a semiconductor layer with a gate insulating film interposed therebetween;

forming a mask pattern over the laminate;

15       etching the second conductive layer and the first conductive layer while recessing the mask pattern over the laminate with the use of plasma to which sulfur hexafluoride is added to form the tapered first conductive layer pattern;

20       selectively etching the second conductive layer in the first conductive layer pattern in accordance with the mask pattern left over the first conductive layer pattern to form a second conductive layer pattern; and

forming a lightly doped drain region in a region of the semiconductor film overlapping with the first conductive layer in the second conductive layer pattern with the second conductive layer in the second conductive layer pattern as a mask for shielding ions accelerated by an electric field.

25       8. The method according to claim 7, wherein the first conductive layer is tantalum nitride, and the second conductive layer is titanium or one of an alloy and a compound including titanium as its main component.

30       9. A method for manufacturing a semiconductor device, comprising the steps of:

laminating a first conductive layer, a second conductive layer, and a third conductive layer sequentially over a semiconductor layer with a gate insulating film interposed therebetween to form a laminate;

35       forming a mask pattern over the laminate;

etching the third conductive layer, the second conductive layer, and the first conductive layer while recessing the mask pattern over the laminate with the use of plasma to which sulfur hexafluoride is added to form the tapered first conductive layer pattern;

40       selectively etching the third conductive layer and the second conductive layer in the first conductive layer pattern in accordance with the mask pattern left over the first conductive layer pattern to form a second conductive layer pattern; and

45       forming a lightly doped drain region in a region of the semiconductor film overlapping with the first conductive layer in the second conductive layer pattern with the third conductive layer and the second conductive layer in the second conductive layer pattern as a mask for shielding ions accelerated by an electric field.

10. The method according to claim 9, wherein the first conductive layer is

tantalum nitride, the second conductive layer is titanium or one of an alloy and a compound including titanium as its main component, and the third conductive layer is titanium nitride.

5 11. A method for manufacturing a semiconductor device, comprising the steps of:

forming a laminate comprising a lower first conductive layer and an upper second conductive layer over a semiconductor layer with a gate insulating film interposed therebetween;

10 forming a mask pattern over the laminate;

using a condition that has a high selective ratio of the mask pattern to the second conductive layer and etching the second conductive layer and the first conductive layer to form a tapered first conductive layer pattern;

15 selectively etching the second conductive layer in the first conductive layer pattern in accordance with the mask pattern left over the first conductive layer pattern to form a second conductive layer pattern; and

20 forming a lightly doped drain region in a region of the semiconductor film overlapping with the first conductive layer in the second conductive layer pattern with the second conductive layer in the second conductive layer pattern as a mask for shielding ions accelerated by an electric field.

25 12. The method according to claim 11, wherein the first conductive layer is tantalum nitride, and the second conductive layer is titanium or one of an alloy and a compound including titanium as its main component.

30 13. The method according to claim 11, wherein the second conductive layer and the first conductive layer are etched while recessing the mask pattern over the laminate with the use of plasma to which sulfur hexafluoride is added to form the tapered first conductive layer pattern.

14. A method for manufacturing a semiconductor device, comprising the steps of:

35 laminating a first conductive layer, a second conductive layer, and a third conductive layer sequentially over a semiconductor layer with a gate insulating film interposed therebetween to form a laminate;

forming a mask pattern over the laminate;

using a condition that has a high selective ratio of the mask pattern to the second conductive layer and etching the third conductive layer, the second conductive layer, and the first conductive layer to form a tapered first conductive layer pattern;

40 selectively etching the third conductive layer and the second conductive layer in the first conductive layer pattern in accordance with the mask pattern left over the first conductive layer pattern to form a second conductive layer pattern; and

45 forming a lightly doped drain region in a region of the semiconductor film overlapping with the first conductive layer in the second conductive layer pattern with the third conductive layer and the second conductive layer in the second conductive layer pattern as a mask for shielding ions accelerated by an electric field.

15. The method according to claim 14, wherein the first conductive layer is

tantalum nitride, the second conductive layer is titanium or one of an alloy and a compound including titanium as its main component, and the third conductive layer is titanium nitride.

- 5      16. The method according to claim 14, wherein the third conductive layer, the second conductive layer, and the first conductive layer are etched while recessing the mask pattern over the laminate with the use of plasma to which sulfur hexafluoride is added to form the tapered first conductive layer pattern.